

VISION MONITORING OF HEAD-DOWN TILT BED REST SUBJECTS

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Vision Changes in Astronauts

- Visual changes discovered in astronauts following long-duration (>6 months) spaceflight raised concern about ocular health during long duration spaceflight. Findings include:
 - Hyperopic shifts
 - choroidal folds
 - optic disc edema
 - retinal nerve fiber layer (RNFL) thickening
 - cotton wool spots were some of the findings observed

Link to Bed Rest

- Hypotheses speculate that hypertension in the brain caused by cephalad fluid shifts during spaceflight is a possible mechanism for these ocular changes found in astronauts.
- Head-down tilt (HDT) bed rest is a spaceflight analog that induces cephalad fluid shifts.
 - Previous studies of the HDT position demonstrated body fluid shifts associated with changes in intraocular pressure (IOP).
 - Vision monitoring of HDT bed rest subjects was implemented

Vision Monitoring: Bed Rest

- Vision monitoring was completed on 4 subjects participating in a 30-day 6° HDT bed rest study. Of these 4 subjects, 2 received post bed rest testing only, and 2 received pre- and post bed rest testing.
- Findings from 2 subjects receiving pre- and post bed rest testing will be presented in detail.
- There was no clinical evidence of choroidal folds or optic disc edema in any of the subjects examined. However, in the 2 subjects receiving only post bed rest exams, findings from optical coherence tomography (OCT) indicated possible RNFL thickening. This was difficult to determine however, without pre-testing information.

Subject 1: 30-day bed rest

Ophthalmic examinations were performed at baseline, one day (BR+1) and 6 months (BR+180) post bed rest .

At baseline:

- A.B.
- 25-year-old
Caucasian male
- General good health
- No vision related complaints
- Best corrected visual acuity:
20/20 both eyes
- Intraocular pressure (mmHg):
15 right eye; 14 left eye
- Cycloplegic refraction:
-3.25 sph +0.25 cyl ax 80 right
eye
-3.00 sph +0.75 cyl ax 90 left eye

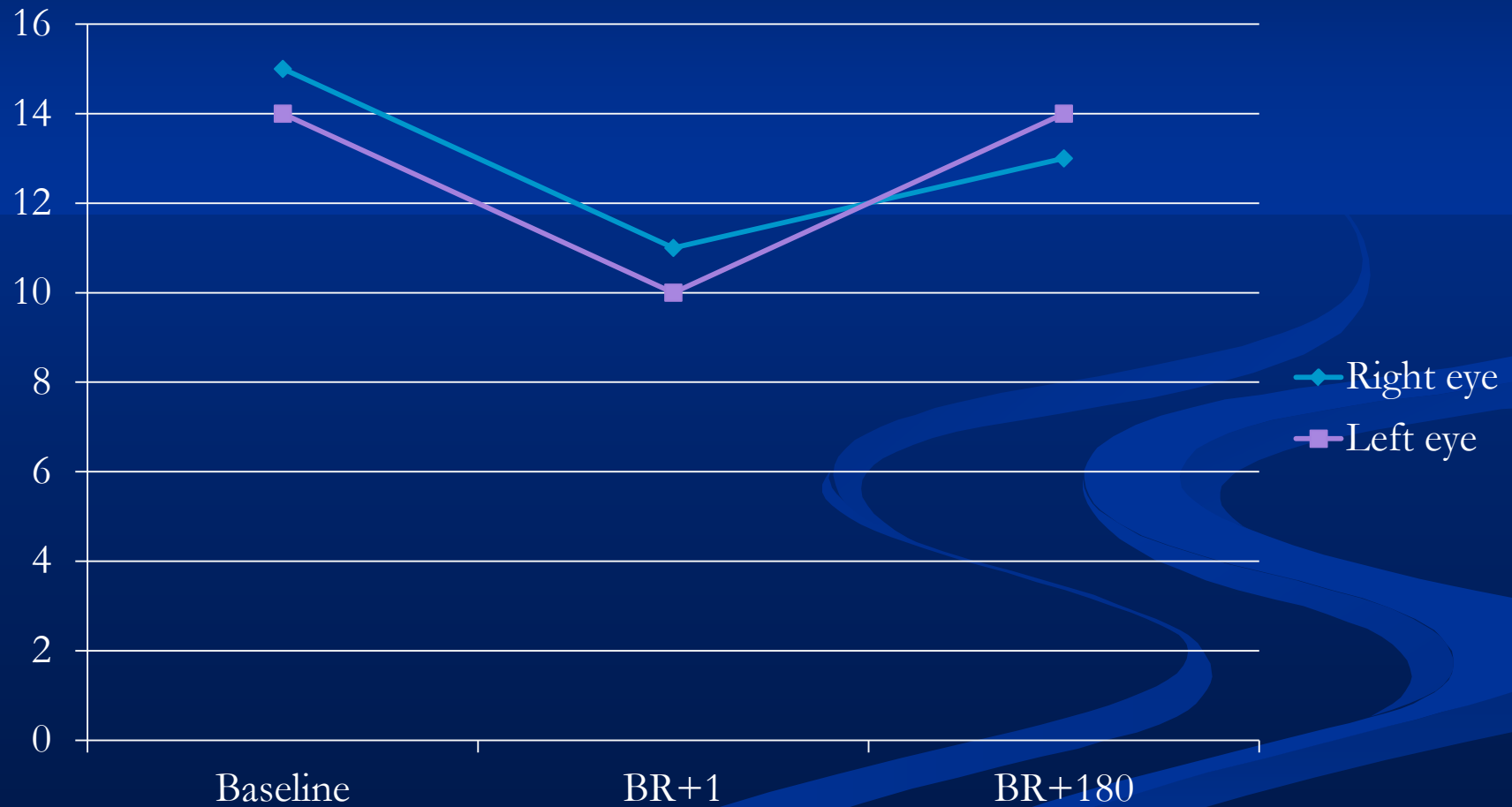
BR+1:

- Best corrected visual acuity: 20/20 right eye; 20/15 left eye
- Intraocular pressure (mmHg): 11 right eye; 10 left eye
- Cycloplegic refraction:
 - 3.25 sph +0.25 cyl ax 80 right eye
 - 3.00 sph +0.75 cyl ax 90 left eye

BR+180:

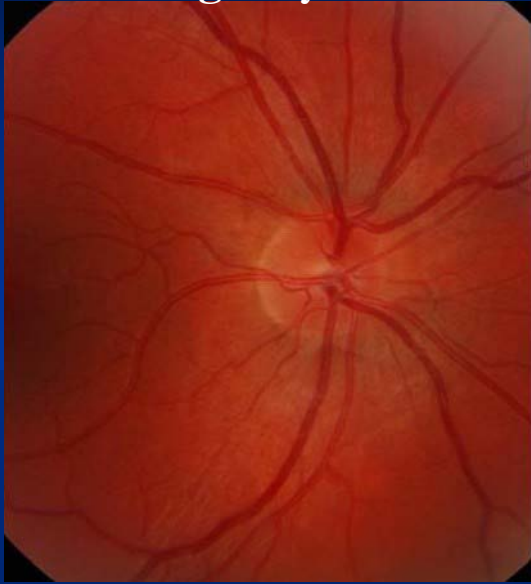
- Best corrected visual acuity: 20/20 right eye;
20/20 left eye
- Intraocular pressure (mmHg): 13 right eye; 14
left eye
- Cycloplegic refraction:
 - 3.50 sph +0.50 cyl ax 80 right eye
 - 2.75 sph +0.75 cyl ax 90 left eye

Intraocular pressure



Baseline versus BR+1

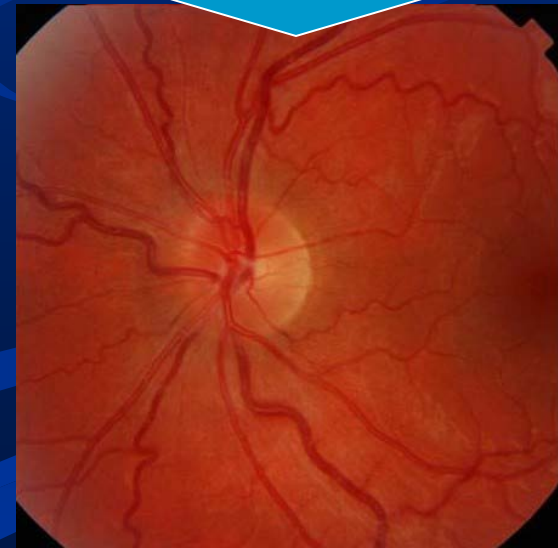
Right eye



Baseline

BR+1

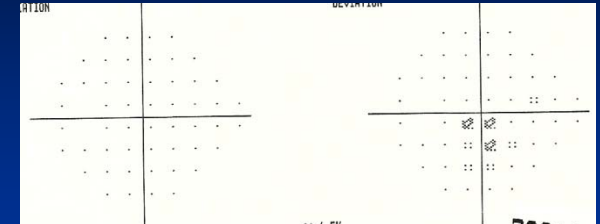
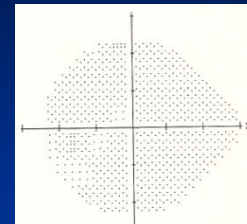
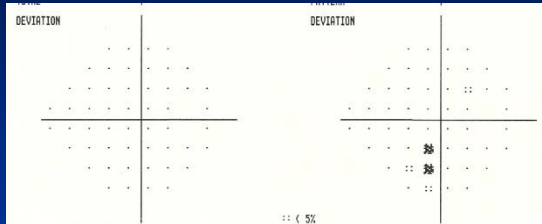
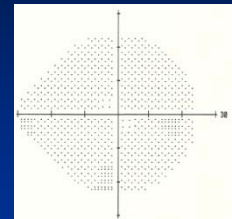
Left eye



Right eye

Left eye

Baseline



Grey scale

Total deviation

Pattern deviation

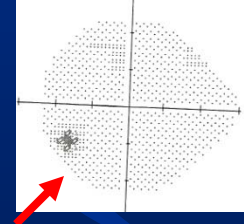
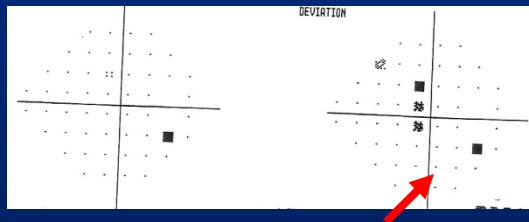
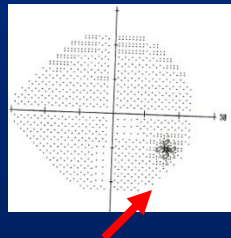
Grey scale

Total deviation

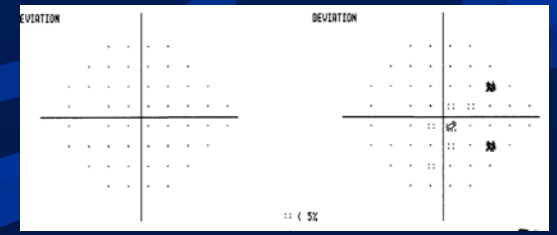
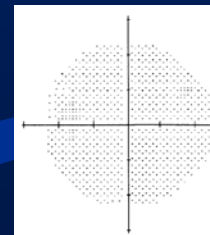
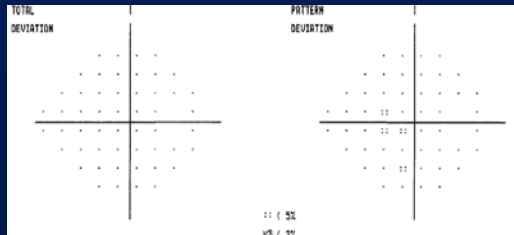
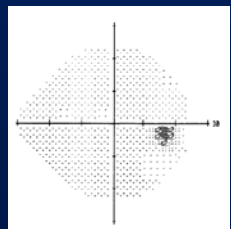
Pattern deviation



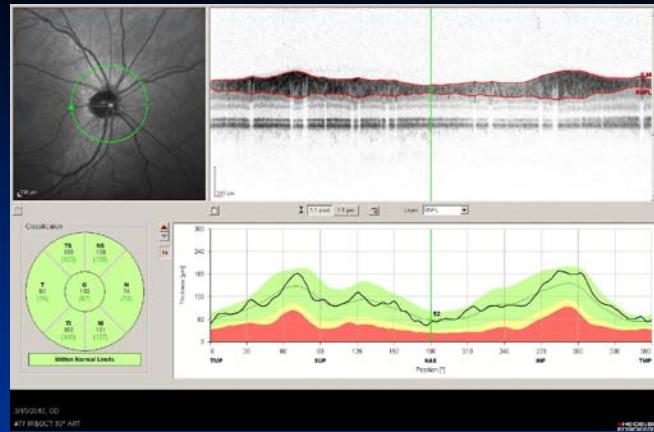
BR+1



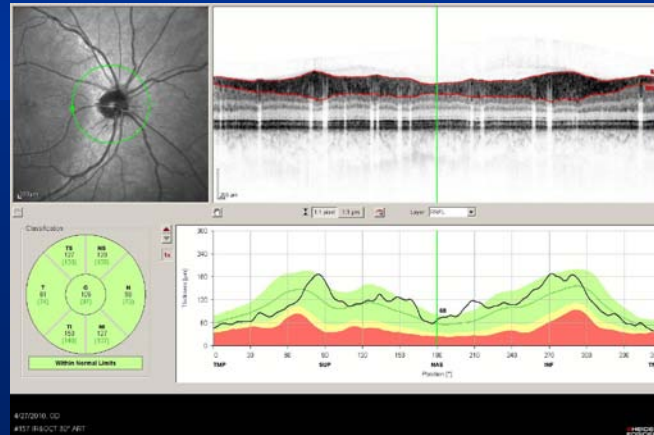
BR+180



Baseline

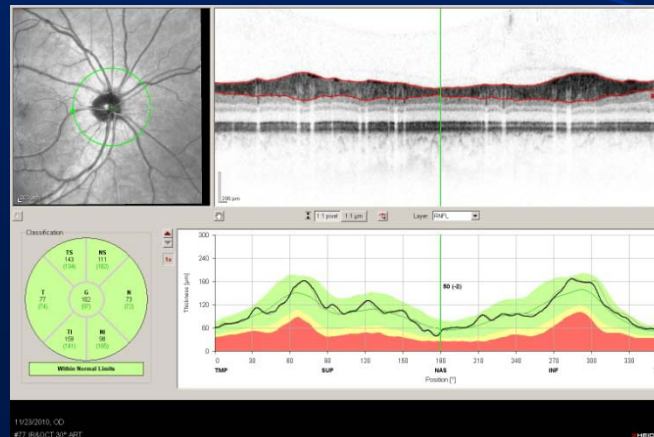


BR+1

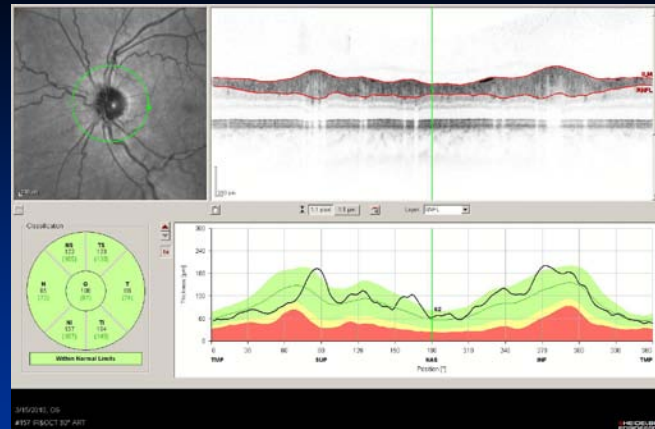


Right eye

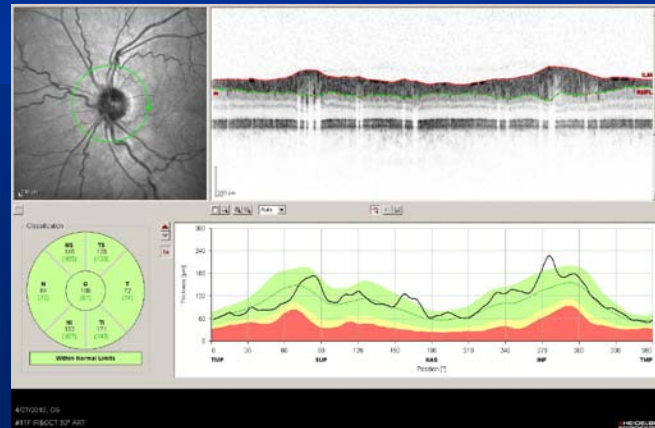
BR+180



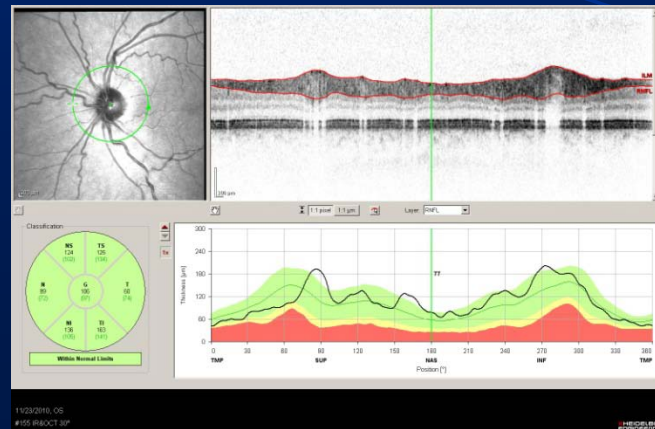
Baseline



BR+1

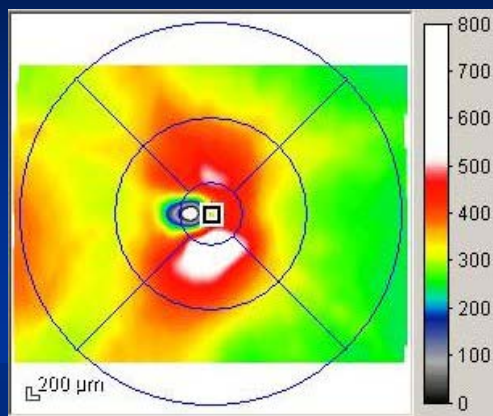


BR+180

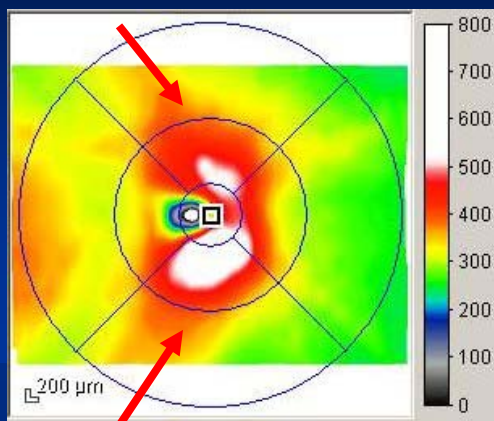


Left eye

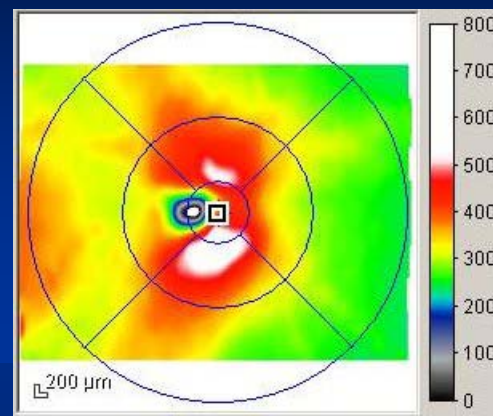
SD-OCT retinal thickness scans centered on the optic disc (20°x15°, 512 A-scans x 19 B-scans)



Baseline

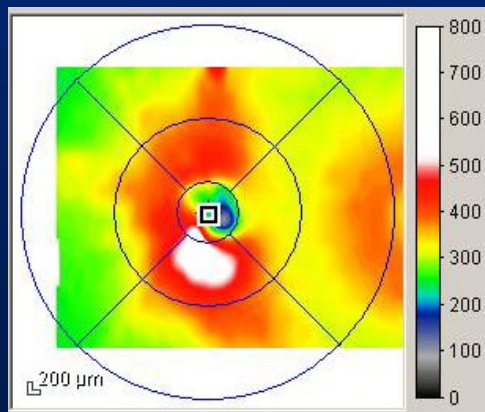


BR+1

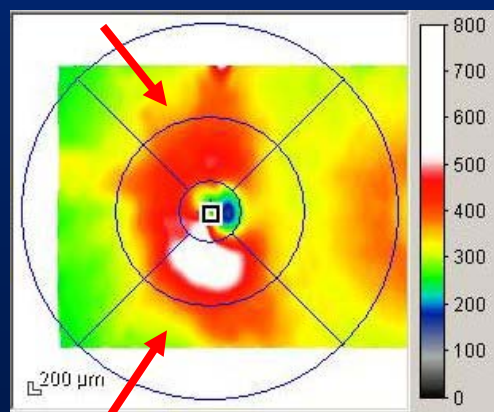


BR+180

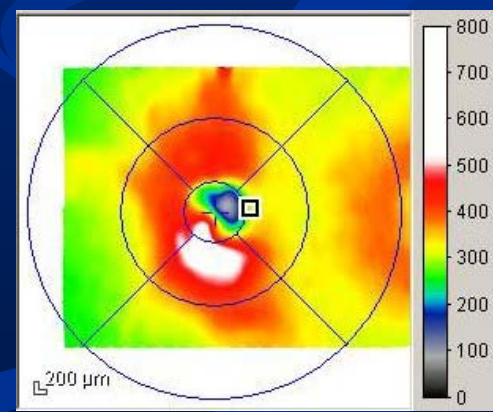
Right eye



Baseline



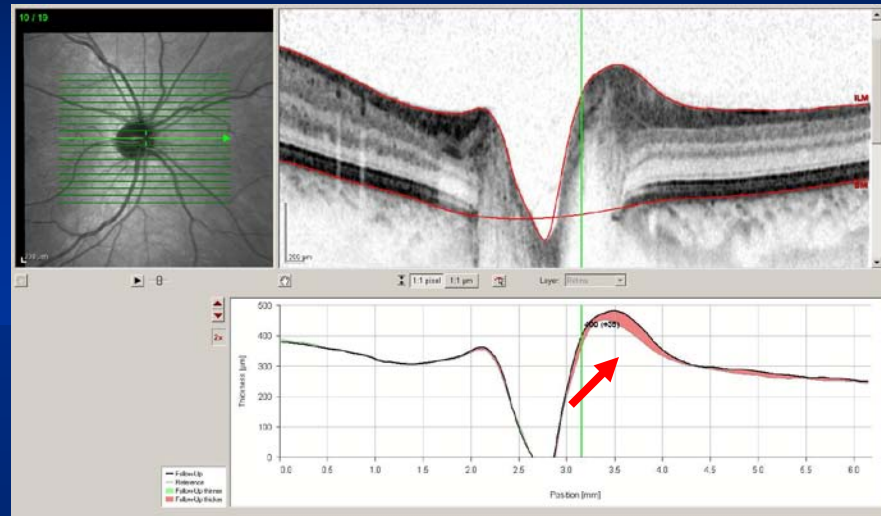
BR+1



BR+180

Left eye

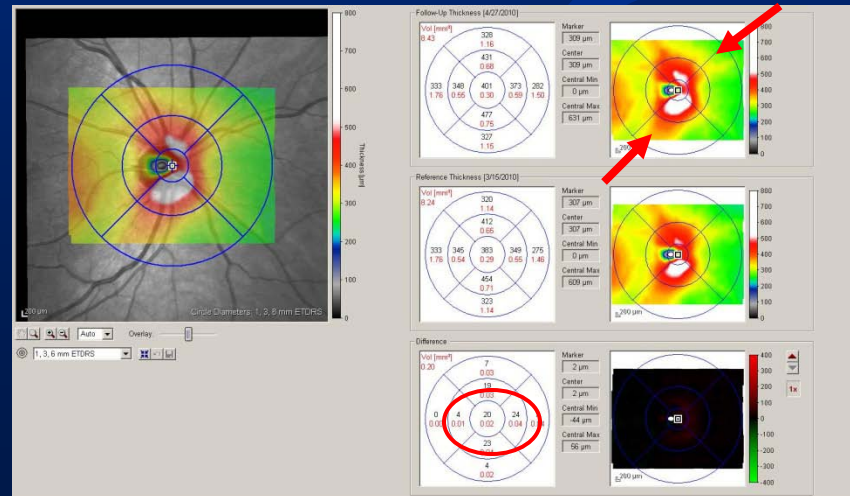
Baseline versus BR+1



4/27/2010, 00
#137 R&OCT 30°

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engineering

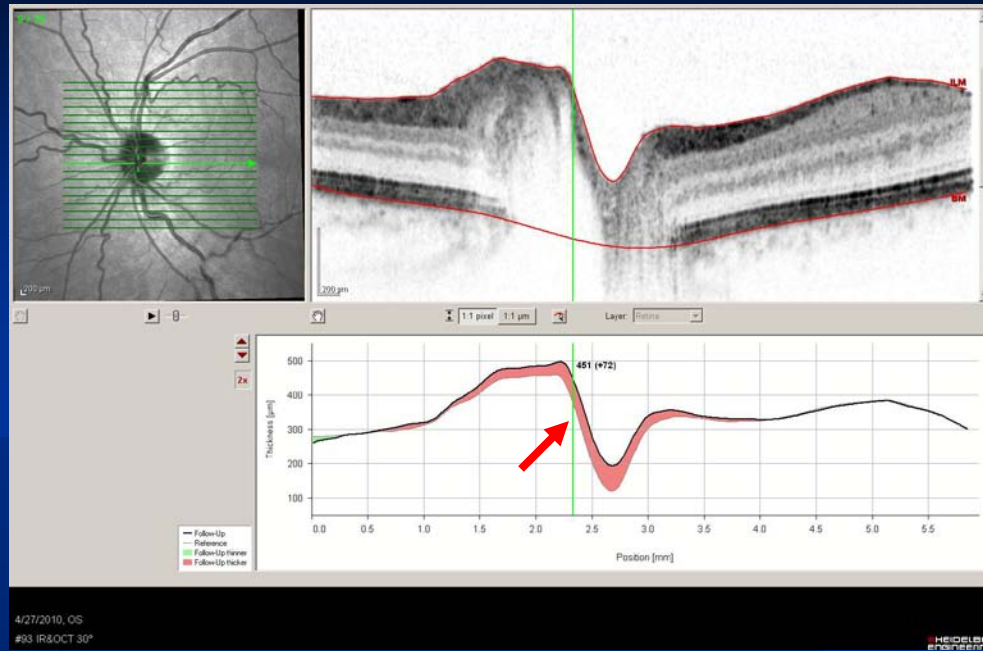
Right eye



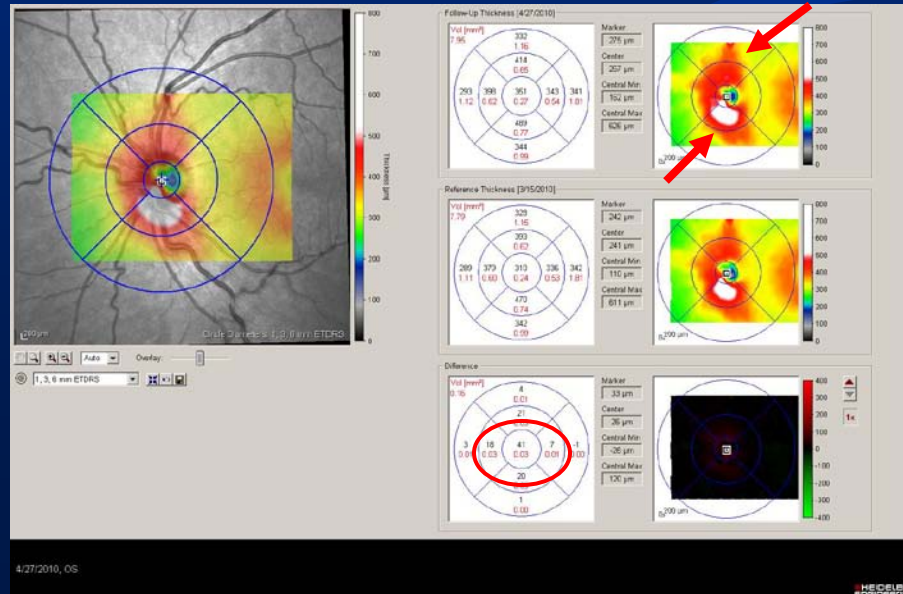
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engineering

Baseline versus BR+1



Left eye



SD-OCT for identification of change

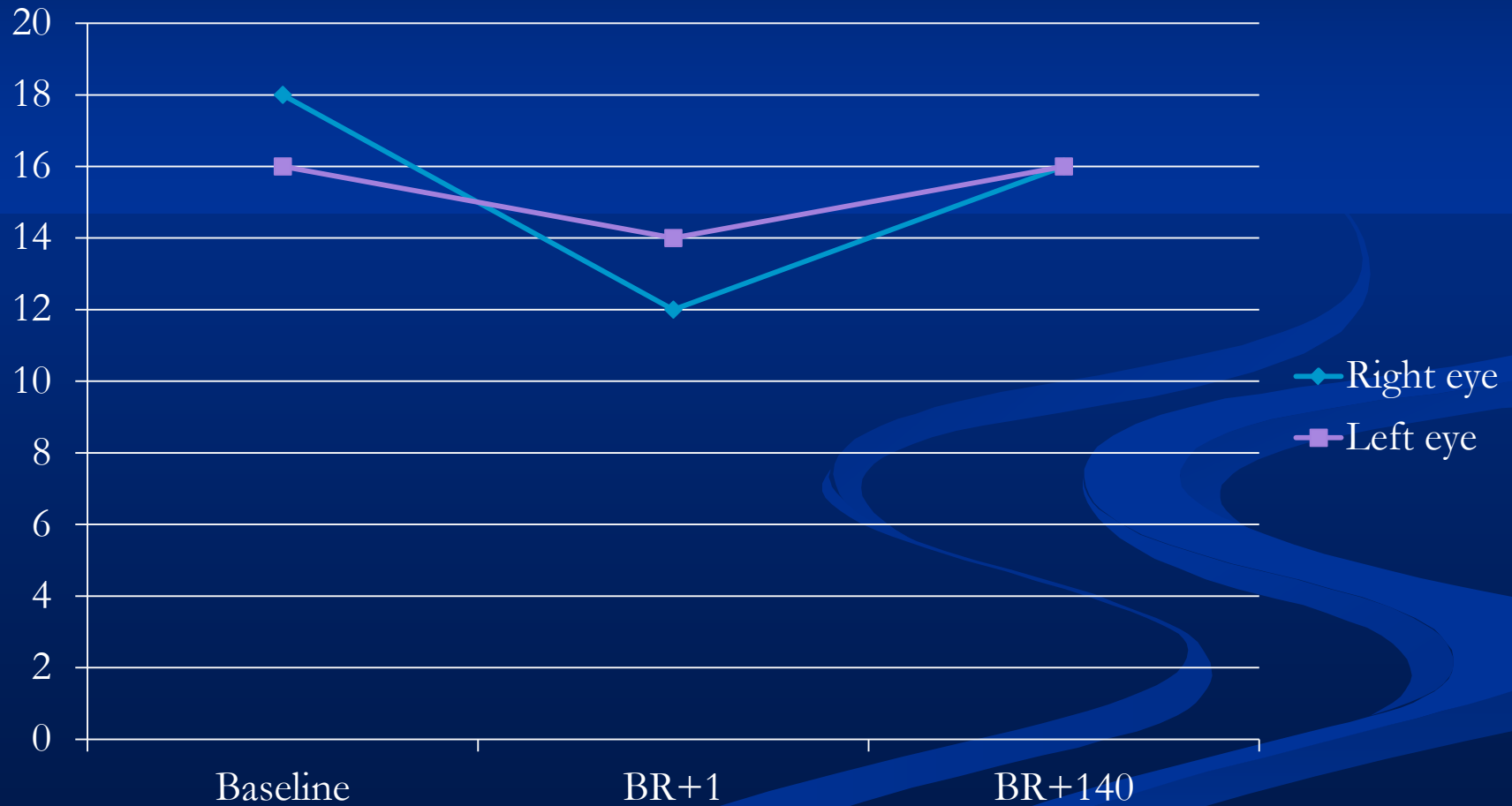
- At **BR+1**, SD-OCT scans showed an **average increase** in retinal thickness of $17.4\ \mu$ (+4.5%) in OD and $21.2\ \mu$ (+5.6%) in OS compared to baseline. However, there were no clinically detectable signs of optic disc edema.
- At **BR+180**, SD-OCT measurements **matched the ones recorded at baseline** (e.g., average retinal thickness was 389 and 388 μ at baseline and 6 month follow-up, respectively, in OD, while it was 378 μ in OS).

Subject 2: 30-day bed rest

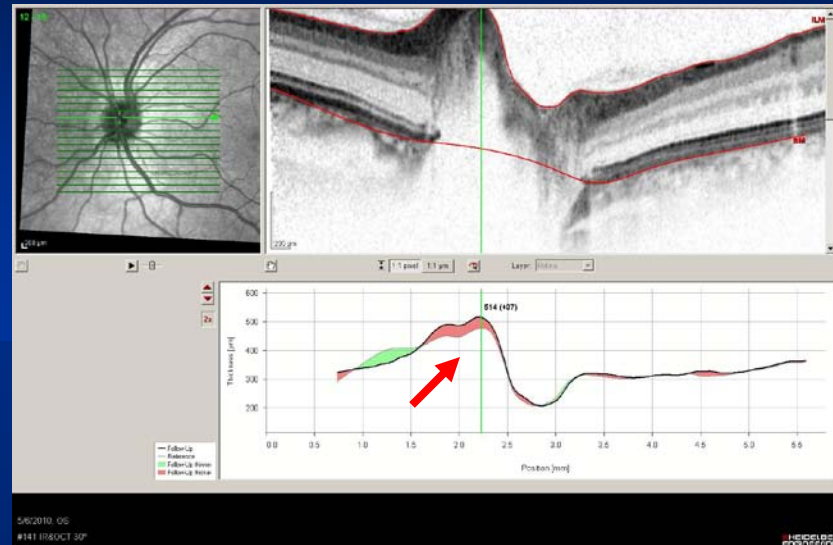
Ophthalmic examinations were performed at baseline, BR+1 and BR+140 (at a different location).

- C.D., 27-year-old Caucasian male complained about blurry vision at BR+1 visit and at BR+140.
- However, best corrected visual acuity was 20/20 in both eyes at all visits.
- Cycloplegic refraction was identical at all visits and confirmed the presence of a slight myopia.

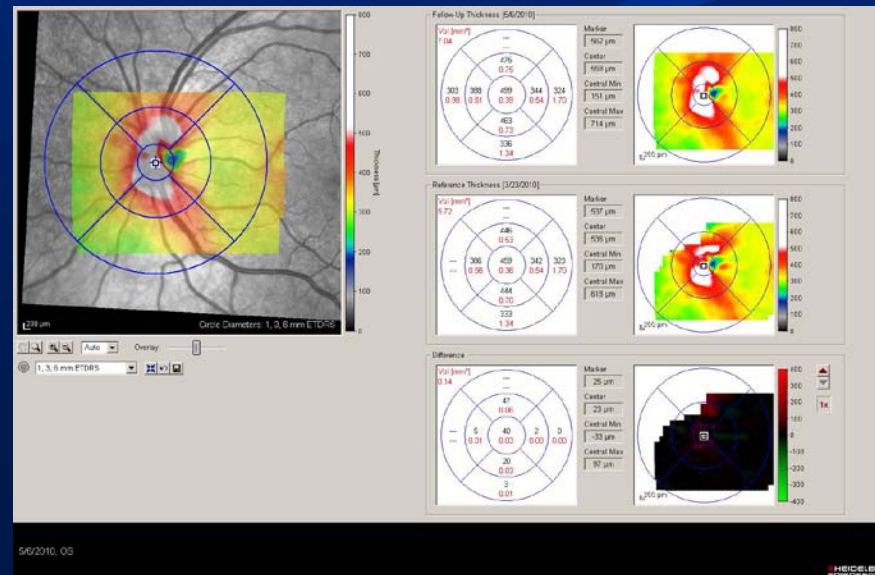
Intraocular pressure



Baseline versus follow-up



Left eye



Summary

- Intraocular pressure was decreased compared to baseline immediately post bed rest (as suggested by previous studies)
- SD-OCT was able to identify subtle changes at the level of the optic nerve head otherwise undetected on clinical examination
- In subject 1 structural changes somewhat correlated with changes seen on Standard Automated Perimetry (bilateral scotoma?)
- In subject 1, measurements tended to return to baseline level at BR+180 with resolution of the scotoma

Limitations

- Only two subjects were examined pre and post bed rest. However, a similar trend was identified with regard to intraocular pressure measurements and SD-OCT findings for these subjects.
- MRIs were not available.
- Intracranial pressure was not measured/estimated.
- Limited follow-up

Conclusions

- While subclinical changes were identified in bed rest subjects, findings did not replicate those observed in astronauts.
- Further study of long-duration bed rest is needed to determine the visual consequences of HDT bed rest if any, and determine if HDT bed rest can serve as a ground based model to study space-related changes in vision.